Discipline	Course Number	Title
Mathematics	160	MTH 160 06/05/2023-Basic Statistics
College	Division	Department
Math, Science and Engineering Tech	Math, Science and Engineering Tech	Math & Engineering Studies
Faculty Preparer		Robert Klemmer
Date of Last Filed Assessment Report		08/05/2021

I. Review previous assessment reports submitted for this course and provide the following information.

1. Was this course previously assessed and if so, when?

   > Yes
   >
   > Math 160 was last assessed in Winter 2021 by Bobby Klemmer.

2. Briefly describe the results of previous assessment report(s).

   > As seen in the table below, in 2021, we had achieved our desired threshold of at least 70% of students earning a 70% on each course outcome from the master syllabus. The final exam was the assessment tool for this analysis.
   >
   > | | Percentage of Students Achieving at least 70% | | | |
   > |---|---|---|---|---|
   > | | Course Outcome 1 | Course Outcome 2 | Course Outcome 3 | Course Outcome 4 |
   > | Winter 2017 | 87% | 86% | 62% | 86% |
   > | Winter 2019 | 90% | 88% | 78% | 84% |
   > | Winter 2021 | 94% | 91% | 82% | 72% |

3. Briefly describe the Action Plan/Intended Changes from the previous report(s), when and how changes were implemented.

   > The main area of concern from the previous assessment report involved the decline in student success with Outcome 4 of the course. Given that decline, the previous action plan included collaboration of Math 160 teachers in the Summer

of 2021, resulting in course video enhancements for the final unit of the online course (implemented Fall 2021). Additionally, new student-teacher engagement activities were added to the online course for this unit (implemented Fall 2021). And, as part of the syllabus update that accompanied the previous assessment report, the standard of success for each outcome was raised. We decided to aim for at least 75% of students earning at least 70% on each outcome. It is worth noting that the previous assessment report was based solely on online and virtual classes, as we were in the midst of the Covid-19 pandemic.

II. Assessment Results per Student Learning Outcome

Outcome 1: Identify common statistical terminology, and represent qualitative and quantitative data in tables and graphs.

- Assessment Plan
    - Assessment Tool: Outcome-related common final exam questions
    - Assessment Date: Spring/Summer 2023
    - Course section(s)/other population: All
    - Number students to be assessed: 10-20% representative random sample of students
    - How the assessment will be scored: The selected set of common questions for this outcome from the approved department final exam will be scored with a rubric
    - Standard of success to be used for this assessment: 75% of students will score at least 70% on the selected set of questions assessed for this outcome
    - Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2023	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
590	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

> Random sampling of 100 students sufficiently provides the needed data to note our success with each learning outcome. The 100 students assessed reflects approximately 17% of all students in Math 160 for the Winter 2023 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

> During the Winter 2023 semester, 220 students (37%) took the class in a face-to-face format, while the remaining 370 students (63%) took the course in an online or virtual format. The sample analyzed for this assessment reflects this exact breakdown of students: 63 online/virtual students and 37 face-to-face students were randomly selected.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

> A common final exam for Math 160 was used to assess all learning outcomes. A proctored final exam was administered via Connect Math for online/virtual classes, and an equivalent paper final exam was administered to face-to-face classes during the Winter 2023 semester. 63 students were randomly selected from online/virtual sections and 37 students were randomly selected from face-to-face sections. I reviewed all questions on all exams, regrading for consistency. Each question was worth 1 point, and I graded with partial credit ranging between 0 and 1 for each. Outcome 1 included questions 1-4 and 13 for the online final exam and questions 1-4 and 26 for the paper final exam. Upon regrading all exams for this outcome, I found the total number of points earned for each student (up to a maximum of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

> Met Standard of Success: Yes
>
> 97 out of the 100 students assessed scored above 70% on Outcome 1 for the final. Additionally, the mean score for Outcome 1 was found to be 93%. This

data reveals that our students achieved on a very high level with this outcome, far exceeding the standard of success of at least 75% of students earning at least 70%.

Results below also indicate an improvement upon previous assessments of this objective in 2021 and 2019. The table shows the percentage of students earning at least 70% on Outcome 1.

	Course Outcome 1
Winter 2019	90%
Winter 2021	94%
Winter 2023	97%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students continue to demonstrate a strong understanding of statistical terminology and how to characterize and visually represent both qualitative and quantitative data. The improvement from 2019 to 2021 to now is also promising with this course outcome, as is the consistency between the outcome success rates in online/virtual and face-to-face classes. Both online/virtual and face-to-face students in the sample had an identical 97% success rate for this learning outcome. Students are clearly attaining a thorough understanding of statistical terminology and how to represent qualitative and quantitative data regardless of the learning modality.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Plans for continuous improvement include sharing these results with all Math 160 instructors and further collaboration with the entire Math 160 team. Given the many sections, modalities, and instructors for this course, we all have the opportunity to learn a lot from each other. Despite the high scores, students can still improve their own communication of statistical terminology. The Math 160 team can also consider adding additional content/terminology to the course for this particular learning outcome.

Outcome 2: Interpret, plan, produce and apply descriptive statistics, including common quantitative measures for univariate data and common quantitative measures related to linear regression analysis of bivariate data.

- Assessment Plan

  - o Assessment Tool: Outcome-related common final exam questions

  - o Assessment Date: Spring/Summer 2023

  - o Course section(s)/other population: All

  - o Number students to be assessed: 10-20% representative random sample of students

  - o How the assessment will be scored: The selected set of common questions for this outcome from the approved department final exam will be scored with a rubric

  - o Standard of success to be used for this assessment: 75% of students will score at least 70% on the selected set of questions assessed for this outcome

  - o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2023	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
590	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

   Random sampling of 100 students sufficiently provides the needed data to note our success with each learning outcome. The 100 students assessed reflects approximately 17% of all students in Math 160 for the Winter 2023 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

   During Winter 2023 semester, 220 students (37%) took the class in a face-to-face format, while the remaining 370 students (63%) took the course in an online or virtual format. The sample analyzed for this assessment reflects this exact

breakdown of students: 63 online/virtual students and 37 face-to-face students were randomly selected.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

A common final exam for Math 160 was used to assess all outcomes. A proctored final exam was administered via Connect Math for online/virtual classes, and an equivalent paper final exam was administered to face-to-face classes during the Winter 2023 semester. 63 students were randomly selected from online/virtual sections and 37 students were randomly selected from face-to-face sections. I reviewed all questions on all exams, regrading for consistency. Outcome 2 included questions 5-9 from the online final exam and questions 5-19 on the paper final exam. Each question was worth 1 point on the online final, and I graded with partial credit ranging between 0 and 1 for each. On the paper final, questions 5-7 correlated directly with question 5 from the online final, questions 8-9 correlated directly with question 6 from the online final, questions 10-12 correlated directly with question 7 from the online final, questions 13-16 correlated directly with question 8 from the online final, and questions 17-19 correlated directly with question 9 from the online final. These groups of questions from the paper final were also given a total score between 0 and 1, with partial credit awarded as appropriate. Upon regrading all exams for this learning outcome, I found the total number of points earned for each student (up to a maximum of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

91 out of the 100 students assessed scored above a 70% on Outcome 2 for the final. Additionally, the mean score for Outcome 2 was found to be 89%. This data reveals that our students achieved on a very high level with this outcome, far exceeding the standard of success of at least 75% of students earning at least 70%.

Results below also indicate an improvement upon a previous assessment of this objective in 2019 and a consistent result with the 2021 analysis:

	Course Outcome 2
Winter 2019	88%
Winter 2021	91%

Winter 2023	91%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students continue to demonstrate a strong ability to interpret, plan, produce, and apply descriptive statistics. The consistent high rate of success with this learning outcome over the last few assessments is positive, as is the consistency between the outcome success rates in online/virtual and face-to-face classes (Online/virtual students from the sample had a 94% success rate with this outcome while face-to-face students from the sample had an 86% success rate for this learning outcome). The varied tools that students and instructors are using in Math 160 are proving effective at giving students the opportunity to master the descriptive statistics component of the course.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Plans for continuous improvement include sharing these results with all Math 160 instructors and further collaboration with the entire Math 160 team. Given the many sections, modalities, and instructors for this course, we all have the opportunity to learn a lot from each other. Despite the high scores, students have access to many computational tools and resources today, so it will be important to consider those tools in our instruction as we continue to aim for high success rates with this outcome in the future.

Outcome 3: Interpret and apply probability, discrete probability distributions and common continuous probability distributions.

- Assessment Plan

    o Assessment Tool: Outcome-related common final exam questions

    o Assessment Date: Spring/Summer 2023

    o Course section(s)/other population: All

    o Number students to be assessed: 10-20% representative random sample of students

    o How the assessment will be scored: The selected set of common questions for this outcome from the approved department final exam will be scored with a rubric

- o Standard of success to be used for this assessment: 75% of students will score at least 70% on the selected set of questions assessed for this outcome

- o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2023	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
590	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning outcome. The 100 students assessed reflects approximately 17% of all students in Math 160 for the Winter 2023 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

During Winter 2023 semester, 220 students (37%) took the class in a face-to-face format, while the remaining 370 students (63%) took the course in an online or virtual format. The sample analyzed for this assessment reflects this exact breakdown of students: 63 online/virtual students and 37 face-to-face students were randomly selected.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

A common final exam for Math 160 was used to assess all outcomes. A proctored final exam was administered via Connect Math for online/virtual classes, and an equivalent paper final exam was administered to face-to-face classes during the Winter 2023 semester. 63 students were randomly selected from online/virtual sections and 37 students were randomly selected from face-to-face sections. I reviewed all questions on all exams, regrading for consistency. Outcome 3 included questions 10-12 and 14-15 from the online final exam and questions 20-

25 and 27-34 from the paper final exam. Each question was worth 1 point on the online final, and I graded with partial credit ranging between 0 and 1 for each. On the paper final, question 20 correlated directly with question 10 from the online final, questions 21-22 correlated directly with question 11 from the online final, questions 23-25 correlated directly with question 12 from the online final, questions 27-29 correlated directly with question 14 from the online final, and questions 30-34 correlated directly with question 15 from the online final. These groups of questions from the paper final were also given a total score between 0 and 1, with partial credit awarded as appropriate. Upon regrading all exams for this learning outcome, I found the total number of points earned for each student (up to a maximum of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes
85 out of the 100 students assessed scored above a 70% on Outcome 3 for the final. Additionally, the mean score for Outcome 3 was found to be 86%. This data reveals that our students achieved on a very high level with this outcome, far exceeding the standard of success of at least 75% of students earning at least 70%. Results below also indicate an improvement upon previous assessments of this objective in 2021 and 2019: 		Course Outcome 3
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Winter 2019	78%
Winter 2021	82%
Winter 2023	85%	

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students have demonstrated a significant improvement in the ability to interpret and apply probability examples, including working with discrete and continuous probability distributions. The improvement from 2019 to 2021 to now is also promising with this course outcome, as is the consistency between the outcome success rates in online/virtual and face-to-face classes (84% of online/virtual students from the sample and 86% of the face-to-face students from

the sample attained at least 70% success). It is also worth noting that the success rate for this outcome was a mere 62% in 2017. Students have improved substantially over time with their ability to succeed in the challenging probability component of the course.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Plans for continuous improvement include sharing these results with all Math 160 instructors and further collaboration with the entire Math 160 team. Given the many sections, modalities, and instructors for this course, we all have the opportunity to learn a lot from each other. Some concepts within this outcome still challenge many students (the most-missed question on the final involved this outcome), so it is pivotal to maintain a dialogue on best practices for teaching probability.

Outcome 4: Interpret, plan, produce and apply inferential statistics.

- Assessment Plan

  o Assessment Tool: Outcome-related common final exam questions

  o Assessment Date: Spring/Summer 2023

  o Course section(s)/other population: All

  o Number students to be assessed: 10-20% representative random sample of students

  o How the assessment will be scored: The selected set of common questions for this outcome from the approved department final exam will be scored with a rubric

  o Standard of success to be used for this assessment: 75% of students will score at least 70% on the selected set of questions assessed for this outcome

  o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2023	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
590	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning outcome. The 100 students assessed reflects approximately 17% of all students in Math 160 for the Winter 2023 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

During Winter 2023 semester, 220 students (37%) took the class in a face-to-face format, while the remaining 370 students (63%) took the course in an online or virtual format. The sample analyzed for this assessment reflects this exact breakdown of students: 63 online/virtual students and 37 face-to-face students were randomly selected.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

A common final exam for Math 160 was used to assess all outcomes. A proctored final exam was administered via Connect Math for online/virtual classes, and an equivalent paper final exam was administered to face-to-face classes during the Winter 2023 semester. 63 students were randomly selected from online/virtual sections and 37 students were randomly selected from face-to-face sections. I reviewed all questions on all exams, regrading for consistency. Outcome 4 included questions 16-19 from the online final exam and questions 35-47 on the paper final exam. Each question was worth 1 point on the online final, and I graded with partial credit ranging between 0 and 1 for each. On the paper final, questions 35-36 correlated directly with question 16 from the online final, questions 37-39 correlated directly with question 17 from the online final, questions 40-43 correlated directly with question 18 from the online final, and questions 44-47 correlated directly with question 19 from the online final. These groups of questions from the paper final were also given a total score between 0 and 1, with partial credit awarded as appropriate. Upon regrading all exams for this learning outcome, I found the total number of points earned for each student (up to a maximum of 4), and finally determined how many students earned a 2.8 or above out of the 4 possible points (since 2.8 out of 4 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: <u>Yes</u>
81 out of the 100 students assessed scored above a 70% on Outcome 4 for the final. Additionally, the mean score for Outcome 1 was found to be 83%. This data reveals that our students achieved on a high level with this outcome, exceeding the standard of success of at least 75% of students earning at least 70%. As this learning outcome was a major focus of our last action plan, it is great to see the improvement since the last assessment report. Results below also indicate an improvement upon previous assessments of this objective in 2021 and 2019: <table><tr><td></td><td>Course Outcome 1</td></tr><tr><td>Winter 2019</td><td>84%</td></tr><tr><td>Winter 2021</td><td>72%</td></tr><tr><td>Winter 2023</td><td>81%</td></tr></table>

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

The improvement between 2021 and now with this inferential statistics learning outcome is one of the highlights of this report. In 2021, only 72% of students attained at least 70%, while now we observe that 81% of students are succeeding with at least 70%. 79% of online/virtual students from the sample met the 70% threshold, and 84% of face-to-face students from the sample met the 70% threshold. The low result in 2021 may have been due to the fact that students didn't have as many opportunities to communicate these concepts in the online format. This is supported by the fact that the success rate this year is a small amount higher with our face-to-face students. In any case, the overall 81% success rate with this outcome is still not quite at the pre-pandemic success levels that we saw in 2017 and 2019 (86% and 84%, respectively).

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

As noted in the 2021 assessment report, these concepts are effectively taught in an environment where repetition can be stressed and conversations can be had with the class. Given that observation, it is not a surprise that face-to-face students fared slightly better with this learning outcome. When these results are shared with Math 160 faculty, we will continue to discuss ways of improving this unit when teaching in virtual and online environments. Creating opportunities for students to engage with each other and instructors will be pivotal to continue to improve upon these results and return to the higher success rates from 2017 and 2019.

III. Course Summary and Intended Changes Based on Assessment Results

1. Based on the previous report's Intended Change(s) identified in Section I above, please discuss how effective the changes were in improving student learning.

We have observed steady increases from 2017 to the present in the proportion of students achieving at least 70% on the first three of the four learning outcomes for Math 160. In 2021, we saw a decline in the proportion of students achieving at least a 70% on outcome 4, but we do see a notable improvement with this outcome now. This is summarized in the table below:

	Percentage of Students Achieving at least 70%			
	Course Outcome 1	Course Outcome 2	Course Outcome 3	Course Outcome 4
Winter 2017	87%	86%	62%	86%
Winter 2019	90%	88%	78%	84%
Winter 2021	94%	91%	82%	72%
Winter 2023	97%	91%	85%	81%

Given that we are still emerging from the challenges of the pandemic, it is somewhat difficult to discuss the effectiveness of the changes made as a result of the 2021 assessment. However, enhancements continue to be made to the online course (which was a focal point after the last assessment), giving students rich and engaging opportunities to learn challenging content, including those inferential statistics concepts related to Outcome 4 in this course.

2. Describe your overall impression of how this course is meeting the needs of students. Did the assessment process bring to light anything about student achievement of learning outcomes that surprised you?

As mentioned earlier, Math 160 has the highest enrollment in the Mathematics department at WCC. Given the upward trend and high proportion of students

achieving above 70% on all of the four learning outcomes, we are confident that our course adjustments are cultivating great learning opportunities and promoting a higher level of student success. One interesting note is that the most missed question on the final exam continues to involve a course objective within Outcome 3. While we observe 85% of our sample achieving at least 70% on Objective 3, we also notice that the course objective related to sampling distributions remains one that students struggle on the most (the mean on this particular question on the final exam was only 69%). By continuing our efforts to enhance student learning opportunities with this specific objective, we hope to continue to see an increase in the proportion of students who are successful on Outcome 3. Additionally, we will continue to reflect on the similarities and differences of the online/virtual and face-to-face classes, particularly focusing on ways of raising success rates for Outcome 4, regardless of learning modality.

3. Describe when and how this information, including the action plan, was or will be shared with Departmental Faculty.

The information in this analysis and report will be shared with past, current and upcoming Math 160 faculty in the near future via email, and the results will be discussed at a meeting prior to the beginning of the Fall semester. An emphasis will be placed on our improvement with all of the four objectives, the importance of continuous improvement in all learning modalities, specific objectives that require our continued attention, as well as the need for collaboration to return to pre-pandemic levels of success on questions related to Outcome 4.

4.

Intended Change(s)

Intended Change	Description of the change	Rationale	Implementation Date
Course Materials (e.g. textbooks, handouts, on-line ancillaries)	This assessment reflects the high level of success that students in Math 160 are having at WCC. Over the last few years, most sections of the course have used Connect Math, a Mcgraw-Hill product, as a tool for completing homework and mastering concepts. Connect Math is	In addition to student satisfaction with Connect Math, the affordable price of ALEKS, and the similarities between Connect Math and ALEKS, ALEKS offers a number of additional enhancements that are likely to bolster student understanding of challenging concepts. For	2023

	being phased out, but a similar McGraw-Hill product, ALEKS, is taking its place. Given student satisfaction with Connect Math, similarities between Connect Math and ALEKS, the affordable cost of ALEKS, and high rates of success that students are experiencing in Math 160, we plan to adopt ALEKS moving forward.	instance, while students are completing homework on any topic, they will also be able to click on a link on that same page as their problem that will take them to a video that their instructor can add to highlight an approach to that problem. There are many tools like this that will allow faculty the opportunity to reinforce lessons in user-friendly ways, while providing the many resources that students already appreciate in Connect Math. Instructors will be able to use the results of this assessment report to also customize their ALEKS classes and provide more students with opportunities to achieve above 70% for the most challenging learning outcomes in the course. These resources have been a pivotal part of the success of Math 160 students over the last few assessments, so this	

		adoption of ALEKS is welcomed.	
Other: Increase student-instructor engagement	We will meet as Math 160 faculty to discuss ways of creating more student-instructor engagement opportunities in all classes, but particularly in online/virtual sections.	Student success in challenging content areas in Statistics requires that students have the ability to engage with their instructor multiple times per week, regardless of learning modality. Given that 84% of face-to-face students attained at least 70% on challenging Outcome 4 on the final exam and that 79% of online/virtual students attained at least 70%, coupled with the fact that success rates on Outcome 4 were lower during the pandemic when all courses were online, it is reasonable to conclude that a high level of student-instructor interaction is vital to give students a better opportunity to learn these difficult concepts. Student demand for online Statistics continues to remain quite high, so enhancements to student-instructor engagement in the	2023

		online setting will go a long way to benefit many students. In a face-to-face format, students also need the ability to connect with their instructor and communicate course content. All educators should continuously consider how to improve their interactions with students to optimize learning opportunities.	

5. Is there anything that you would like to mention that was not already captured?

6.

III. Attached Files

Final Exam Data

Faculty/Preparer: Robert Klemmer **Date:** 06/05/2023
Department Chair: Nichole Klemmer **Date:** 06/07/2023
Dean: Tracy Schwab **Date:** 06/08/2023
Assessment Committee Chair: Jessica Hale **Date:** 11/01/2023

Discipline	Course Number	Title
Mathematics	160	MTH 160 05/20/2021-Basic Statistics
College	Division	Department
	Math, Science and Engineering Tech	Math & Engineering Studies
Faculty Preparer		Robert Klemmer
Date of Last Filed Assessment Report		10/11/2019

I. Review previous assessment reports submitted for this course and provide the following information.

1. Was this course previously assessed and if so, when?

Yes

Math 160 was last assessed in Winter 2019 by both Jim Egan and Bobby Klemmer.

2. Briefly describe the results of previous assessment report(s).

As seen in the table below, in 2019, we had achieved our desired threshold of at least 70% of students earning a 70% on each course outcome from the master syllabus. The final exam was the assessment tool for this analysis.

	Percentage of Students Achieving 70%+			
	Course Outcome 1	Course Outcome 2	Course Outcome 3	Course Outcome 4
Winter 2017	87%	86%	62%	86%
Winter 2019	90%	88%	78%	84%

3. Briefly describe the Action Plan/Intended Changes from the previous report(s), when and how changes were implemented.

Like assessments prior to 2019, it was clear that some instructors continued to have students do some of their statistical calculations using tables rather than software. This occurred with part-time faculty new to teaching this course who likely were not yet completely comfortable with the software themselves. Instructors using tables were reminded again about the software approach and

were encouraged to learn more about the software and offered training support. In addition, all instructors were informed or reminded about the requirement that students know and use the statistical functions of the TI-84 Plus graphing calculator (or *R* in the department authorized sections).

During the Winter 2019 assessment, it was also recommended that Outcome 1 be rewritten. As stated previously, it was all-encompassing and therefore overlapped the other outcomes. This outcome should emphasize statistical terminology and representation of qualitative and quantitative information in tables and graphs. The Winter 2019 report focused on those things in the assessment of Outcome 1, so this current assessment aligns perfectly with the assessment items from 2019.

II. Assessment Results per Student Learning Outcome

Outcome 1: Identify common statistical terminology, and represent qualitative and quantitative data in tables and graphs.

- Assessment Plan

    o   Assessment Tool: Common final exam questions

    o   Assessment Date: Spring/Summer 2021

    o   Course section(s)/other population: All

    o   Number students to be assessed: 10-20% representative random sample of students completing the assessment instrument in each course section

    o   How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

    o   Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

    o   Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2021	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
634	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning objective. The 100 students assessed reflects over 15% of all students in Math 160 for the Winter 2021 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

Throughout the pandemic, our courses have either been taught in an online or virtual format. In Winter 2021, the number of sections that were virtual and online were 14 and 12, respectively, and the number of students in each format were nearly identical (near 300 each). Given that, my analysis included 50 students randomly selected from virtual classes and 50 students randomly selected from fully online classes.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The common final exam for Math 160 was used to assess all objectives. For consistency and given challenges of administering a paper exam during the pandemic, the final exam was administered via Connect Math for the Winter 2021 semester. 50 students were randomly selected from online sections and 50 students were randomly selected from virtual sections. I reviewed all questions on all exams, regrading for consistency. Each question was worth 1 point, and I graded with partial credit ranging between 0 and 1 for each. Outcome 1 included final exam questions 1-4 and 13. Upon regrading all exams for this objective, I found the total number of points earned for each student (up to a max of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

94 out of the 100 students assessed scored above a 70% on Outcome 1 for the final. Additionally, the mean score for Outcome 1 was found to be 93%. This data reveals that our students achieved on a very high level with this outcome, far exceeding the standard of success of at least 70% of students earning at least 70%.

Results below also indicate an improvement upon previous assessments of this objective in 2019 and 2017:

	Course Outcome 1
Winter 2017	87%
Winter 2019	90%
Winter 2021	94%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students continue to demonstrate a strong understanding of statistical terminology and how to characterize and visually represent both qualitative and quantitative data. The improvement from 2017 to 2019 to now is also promising with this course outcome. Throughout the pandemic, many instructors created course videos, flipped classrooms, and made use of additional alternate teaching strategies, and these results highlight the overwhelming effectiveness of the work of teachers and students during this challenging time.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Plans for continuous improvement include sharing these results with all Math 160 instructors and further collaboration with the entire Math 160 team. Given the many sections and instructors for this course, we all have the opportunity to learn a lot from each other. And, given the varied teaching techniques utilized throughout the pandemic, we now have an opportunity to discuss how we can move forward while incorporating many of our newfound tools and strategies.

Outcome 2: Interpret, plan, produce and apply descriptive statistics, including common quantitative measures for univariate data and common quantitative measures related to linear regression analysis of bivariate data.

- Assessment Plan
  - Assessment Tool: Common final exam questions
  - Assessment Date: Spring/Summer 2021
  - Course section(s)/other population: All

o   Number students to be assessed: 10-20% representative random sample of students completing the assessment instrument in each course section

o   How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

o   Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

o   Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2021	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
634	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning objective. The 100 students assessed reflects over 15% of all students in Math 160 for the Winter 2021 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

Throughout the pandemic, our courses have either been taught in an online or virtual format. In Winter 2021, the number of sections that were virtual and online were 14 and 12, respectively, and the number of students in each format were nearly identical (near 300 each). Given that, my analysis included 50 students randomly selected from virtual classes and 50 students randomly selected from fully online classes.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The common final exam for Math 160 was used to assess all outcomes. For consistency and given challenges of administering a paper exam during the pandemic, the final exam was administered via Connect Math for the Winter 2021 semester. 50 students were randomly selected from online sections and 50 students were randomly selected from virtual sections. I reviewed all questions on all sampled exams, regrading for consistency. Each question was worth 1 point, and I graded with partial credit ranging between 0 and 1 for each. Outcome 2 included final exam questions 5-9. Upon regrading all exams for this outcome, I found the total number of points earned for each student (up to a max of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

91 out of the 100 students assessed scored above a 70% on Outcome 2 for the final. Additionally, the mean score for Outcome 2 was found to be 90%. This data reveals that our students achieved on a very high level with this outcome, far exceeding the standard of success of at least 70% of students earning at least 70%. Results below also indicate an improvement upon previous assessments of this objective from 2019 and 2017:

	Course Outcome 2
Winter 2017	86%
Winter 2019	88%
Winter 2021	91%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students continue to demonstrate a strong ability to interpret, plan, produce, and apply descriptive statistics. The improvement from 2017 to 2019 to now is also promising with this course outcome. Throughout the pandemic, many instructors created course videos, flipped classrooms, and made use of additional alternate teaching strategies, and these results highlight the overwhelming effectiveness of the work of teachers and students during this challenging time.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

> Plans for continuous improvement include sharing these results with all Math 160 instructors and further collaboration with the entire Math 160 team. Given the many sections and instructors for this course, we all have the opportunity to learn a lot from each other. And, given the varied teaching techniques utilized throughout the pandemic, we now have an opportunity to discuss how we can move forward while incorporating many of our newfound tools and strategies

Outcome 3: Interpret and apply probability, discrete probability distributions and common continuous probability distributions.

- Assessment Plan

  o Assessment Tool: Common final exam questions

  o Assessment Date: Spring/Summer 2021

  o Course section(s)/other population: All

  o Number students to be assessed: 10-20% representative random sample of students completing the assessment instrument in each course section

  o How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

  o Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

  o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2021	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
634	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning objective. The 100 students assessed reflects over 15% of all students in Math 160 for the Winter 2021 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

Throughout the pandemic, our courses have either been taught in an online or virtual format. In Winter 2021, the number of sections that were virtual and online were 14 and 12, respectively, and the number of students in each format were nearly identical (near 300 each). Given that, my analysis included 50 students randomly selected from virtual classes and 50 students randomly selected from fully online classes.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The common final exam for Math 160 was used to assess all outcomes. For consistency and given challenges of administering a paper exam during the pandemic, the final exam was administered via Connect Math for the Winter 2021 semester. 50 students were randomly selected from online sections and 50 students were randomly selected from virtual sections. I reviewed all questions on all sampled exams, regrading for consistency. Each question was worth 1 point, and I graded with partial credit ranging between 0 and 1 for each. Outcome 3 included final exam questions 10-12, 14, and 15. Upon regrading all exams for this outcome, I found the total number of points earned for each student (up to a max of 5), and finally determined how many students earned a 3.5 or above out of the 5 possible points (since 3.5 out of 5 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

82 out of the 100 students assessed scored above a 70% on Outcome 3 for the final. Additionally, the mean score for Outcome 3 was found to be 85%. This data reveals that our students achieved on a very high level with this outcome, far

exceeding the standard of success of at least 70% of students earning at least 70%. Results below also indicate an improvement upon previous assessments of this objective from 2019 and 2017:

	Course Outcome 3
Winter 2017	62%
Winter 2019	78%
Winter 2021	82%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Our Math 160 students have demonstrated a significant improvement in the ability to interpret and apply probability examples, including working with discrete and continuous probability distributions. The improvement from 2017 to 2019 to now is also promising with this course outcome. Throughout the pandemic, many instructors created course videos, flipped classrooms, and made use of additional alternate teaching strategies, and these results highlight the overwhelming effectiveness of the work of teachers and students during this challenging time.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Despite our results for this outcome exceeding our results from previous assessments and despite exceeding our threshold for success, the analysis of this outcome does reveal that the concept of the distribution of sample means continues to be the most-missed question of the exam. Question 15 of the final had an average grade of 61% in the sample of 100 students, a result far lower than any other question. This information will be shared with Math 160 faculty, and we will explore ways to supplement our teaching for this concept. As the creator of the content for the online Math 160 sections, I will create some supplemental videos to assist students and simplify the content related to this type of question.

Outcome 4: Interpret, plan, produce and apply inferential statistics.

- Assessment Plan
    - Assessment Tool: Common final exam questions
    - Assessment Date: Spring/Summer 2021

- o   Course section(s)/other population: All

- o   Number students to be assessed: 10-20% representative random sample of students completing the assessment instrument in each course section

- o   How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

- o   Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

- o   Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2021	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
634	100

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Random sampling of 100 students sufficiently provides the needed data to note our success with each learning objective. The 100 students assessed reflects over 15% of all students in Math 160 for the Winter 2021 semester. It is worth noting that Math 160 has the highest enrollment in the Math Department; therefore, sampling is particularly appropriate here.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

Throughout the pandemic, our courses have either been taught in an online or virtual format. In Winter 2021, the number of sections that were virtual and online were 14 and 12, respectively, and the number of students in each format were nearly identical (near 300 each). Given that, my analysis included 50 students randomly selected from virtual classes and 50 students randomly selected from fully online classes.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The common final exam for Math 160 was used to assess all outcomes. For consistency and given challenges of administering a paper exam during the pandemic, the final exam was administered via Connect Math for the Winter 2021 semester. 50 students were randomly selected from online sections and 50 students were randomly selected from virtual sections. I reviewed all questions on all sampled exams, regrading for consistency. Each question was worth 1 point, and I graded with partial credit ranging between 0 and 1 for each. Outcome 4 included final exam questions 16-19. Upon regrading all exams for this objective, I found the total number of points earned for each student (up to a max of 4), and finally determined how many students earned a 2.8 or above out of the 4 possible points (since 2.8 out of 4 reflects our desired achievement threshold of 70%).

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

72 out of the 100 students assessed scored above a 70% on Outcome 4 for the final. Additionally, the mean score for Outcome 4 was found to be 81%. This data reveals that our students achieved with this outcome, albeit barely exceeding the standard of success of at least 70% of students earning at least 70%. Results below also indicate a decrease upon previous assessments of this objective from 2019 and 2017:

	Course Outcome 4
Winter 2017	86%
Winter 2019	84%
Winter 2021	72%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

The analysis of course outcome 4 reveals a notable decrease in the percentage of students achieving at least a 70% on inferential statistics-related questions on the final exam. Previously, in 2019, we observed 84% of our sample meeting our 70% mark, yet now we only see 72% of the sample doing so. On the positive side, we observe a mean of 81% on questions related to this objective. Students

demonstrate a good understanding of key concepts in inferential statistics, but we certainly have room to improve and reflect on ways that the pandemic has challenged us in this regard.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

The results seen here are undoubtedly a result of virtual and online learning in the pandemic. These concepts are effectively taught in an environment where repetition can be stressed and conversations can be had with the class. When these results are shared with Math 160 faculty, we will discuss ways of improving this unit when teaching in virtual and online environments in the future. Creating opportunities for students to engage with each other and instructors will be pivotal to improving upon these results.

III. Course Summary and Intended Changes Based on Assessment Results

1. Based on the previous report's Intended Change(s) identified in Section I above, please discuss how effective the changes were in improving student learning.

We have observed steady increases from 2017 to 2019 to the present in the proportion of students achieving at least 70% on the first three of the four learning outcomes for Math 160. At the same time, we have seen a decline in the proportion of students achieving at least a 70% on outcome 4. This is summarized in the table below:

| | Percentage of Students Achieving ³ 70% | | | |
	Course Outcome 1	Course Outcome 2	Course Outcome 3	Course Outcome 4
Winter 2017	87%	86%	62%	86%
Winter 2019	90%	88%	78%	84%
Winter 2021	94%	91%	82%	72%

Given the unique circumstances that the pandemic has presented, I am unable to conclude whether or not the previous changes in the course impacted these current results. However, with the exception of outcome 4, I am quite satisfied to see a high level of success in the course. Our previous course adjustments, coupled with the professional resources created to support student learning during the pandemic, appear to be promoting student success.

2. Describe your overall impression of how this course is meeting the needs of students. Did the assessment process bring to light anything about student achievement of learning outcomes that surprised you?

As mentioned earlier, Math 160 has the highest enrollment in the Mathematics department at WCC. Given the upward trend and high proportion of students achieving above 70% on three of the four learning outcomes, we are confident that our course adjustments are cultivating greater learning opportunities and promoting a higher level of student success. One interesting note is that the most missed question on the final exam, by far, involves a course objective within Outcome 3. While we observe 82% of our sample achieving at least 70% on Outcome 3, we also notice that the course objective related to sampling distributions remains one that students struggle with the most (the mean on this particular question on the final exam was only 61%). By continuing our efforts to enhance student learning opportunities with this specific objective, we hope to continue to see an increase in the proportion of students who are successful on Outcome 3. Also, as we return to campus and face-to-face courses and supplement online resources for Outcome 4, we also hope to see an increase in that "Inferential Statistics" outcome in a future assessment.

3. Describe when and how this information, including the action plan, was or will be shared with Departmental Faculty.

The information in this analysis and report will be shared with past, current and upcoming Math 160 faculty in the near future via email, and the results will be discussed at an upcoming department meeting. An emphasis will be placed on our improvement with three of the four objectives, specific objectives that require our continued attention, as well as the need for collaboration to return to a high level of success on questions related to Outcome 4.

4.
Intended Change(s)

Intended Change	Description of the change	Rationale	Implementation Date
Course Materials (e.g. textbooks, handouts, on-line ancillaries)	We will enhance the course videos and learning resources for the Math 160 unit covering Inferential Statistics (Outcome 4). At the same time, we will discuss ways of creating	The decline in the proportion of students achieving at least 70% on Outcome 4 is slightly concerning, and we recognize that we will continue to offer many sections	2021

	engagement opportunities for students to discuss the content in this final unit of the course, as communicating the content here is pivotal to deep understanding and overall success.	similar to those online and virtual classes that were offered in the pandemic.	
Other: Standard of success	In an effort to promote a higher level of student success, we will aim for 75% of students achieving at least 70% on the final exam.	We easily observed more than 75% of our students achieving at least 70% on the final exam for three of the four course outcomes, and we would like to challenge ourselves to improve both teacher and student performance related to Outcome 4 for the next assessment and beyond.	2021

5. Is there anything that you would like to mention that was not already captured?

6.

III. Attached Files

Student Data

Faculty/Preparer: Robert Klemmer **Date:** 05/28/2021
Department Chair: Lisa Manoukian **Date:** 06/21/2021
Dean: Victor Vega **Date:** 06/29/2021
Assessment Committee Chair: Shawn Deron **Date:** 08/04/2021

Discipline	Course Number	Title
Mathematics	160	MTH 160 07/03/2019-Basic Statistics
Division	Department	Faculty Preparer
Math, Science and Engineering Tech	Math & Engineering Studies	James Egan
Date of Last Filed Assessment Report		10/19/2017

I. Review previous assessment reports submitted for this course and provide the following information.

1. Was this course previously assessed and if so, when?

> Yes
>
> This course was previously assessed in June, 2017 (approved October, 2017), based upon data collected during the winter term of 2017.

2. Briefly describe the results of previous assessment report(s).

> The recent (2017 & 2015) assessments were very consistent, with strong results for Outcomes 1, 2 and 4, but weaker results for Outcome 3. The 2006 assessment met standards for all 4 outcomes. Between 2006 and 2015, the phrasing of Outcome 3 changed, no longer specifically mentioning discrete probability distributions, though this was and is an important course topic shown in the objectives.

3. Briefly describe the Action Plan/Intended Changes from the previous report(s), when and how changes were implemented.

> The previous assessment identified the following intended changes:
>
> (1) Modification of the phrasing of Outcome 3 to reflect both probability and (as in 2006), discrete probability distributions.
>
> This change was made in the 2017 syllabus revision and has applied since it went into effect.
>
> (2) Modification of the assessment tool to (a) include questions on basic probability and on discrete probability distributions, and (b) to be shorter in the

time required for completion since some face-to-face instructors reported that students were unable to complete it.

(a) Instructors were advised of the need for more emphasis on the probability topics, and the assessment tool was modified to better include them for the Winter 2019 semester.

(b) The instrument was modified to require less time for completion. In addition, it was modified to make as close a match as possible between the paper and online versions.

(3) Modification of (a) the sampling to be a representative random sample of 20% of the students in each section and (b) the success criterion to be that for each outcome, at least 70% of the students will score at least 70%.

(a) 20% sampling was actually used in the 2017 assessment and was used in this one.

(b) The success criterion was actually used in the 2017 assessment and was used in this one.

II. Assessment Results per Student Learning Outcome

Outcome 1: Interpret common statistical concepts and demonstrate critical consumption of statistical information.

- Assessment Plan
    - o Assessment Tool: Common final exam questions
    - o Assessment Date: Winter 2021
    - o Course section(s)/other population: All course sections
    - o Number students to be assessed: 20% representative random sample of students completing the assessment instrument in each course section
    - o How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric
    - o Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome
    - o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2019	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
678	120

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Of the 678 students enrolled in the course, 562 completed the required department-generated, cumulative final exam which includes the embedded course assessment questions.

The course assessment plan requires that a representative random sample of 20% of the students (rounding the figure up to a whole number) from each section be selected for assessment. This was done and generated a total sample of 120 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

There were 26 sections of the course offered in three different modalities (face-to-face, online, blended), four different parts of term, and with face-to-face meeting times during days and evenings, including an extension site class.

The completed final exams from all 26 sections were received and included in this assessment.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The assessment tool for this and the other outcomes is questions embedded within the required department-generated cumulative final exam.

Some background to this assessment:
(1) After the Winter 2017 assessment, it was decided that the final exam should be modified to reduce the time required to complete it. Also, while the paper and online versions were closely aligned, they were not as good a match as possible. Finally, changes were made to the course syllabus that necessitated adjustment to the final exam. The new final exam takes care of all three of these issues.

(2) The previous assessment tool used blocks of questions for each outcome that did not specifically produce percentages of students exactly meeting the 70% criterion. This was—and still could be now—satisfactorily addressed by using interpolation, but for this assessment it was decided to redo the blocks of questions for each outcome to align with the 70% criterion. This was accomplished by selecting five outcome-related questions from the final exam for each outcome and then scoring each question on a 1/0.5/0 scale. A student score of 3.5 out of 5 then corresponds to 70%.

Notes regarding Outcome 1: The last several assessments examined Outcome 1 by using almost all of the final exam. An objective look at that suggests that such a global summary does not help identify troublesome topics or suggest appropriate course changes to improve success. So, it was decided that the 5 questions for the assessment of outcome 1 should focus on measuring how well students recognize statistics terminology they encounter and visually represent both qualitative and quantitative data so that it can be easily interpreted. That was done for this assessment, and it will be recommended that the statement of Outcome 1 be modified for the syllabus update.

Summary of the process: Five Outcome 1 related questions from the required cumulative final exam were selected. Two instructors shared scoring responsibilities and graded each answer on a 1/0.5/0 scale. So, each student earned an Outcome 1 score between 0 and 5. Finally, the number of students out of 120 who scored at least 3.5 (70%) out of 5 was determined and converted to a percentage.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

108 out of 120 students scored 3.5 or better out of 5.

Restated: 90% of students scored 70% or better on Outcome 1.

The following table shows percentages of students scoring at least 70%, 80% and 90%, respectively.

Outcome 1 Score	Percentage of Students
$\geq 70\%$	90%
$\geq 80\%$	86%
$\geq 90\%$	56%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

> Results for this outcome were strong. Students particularly excelled at the graphical representation of qualitative data and the graphical representation of bivariate quantitative data.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

> An item analysis revealed that students met the success standard for each of the five assessment questions used for the outcome. However, they were weaker on vocabulary than on graphical work. Statistical vocabulary needs to be emphasized and reinforced throughout the course of instruction.

Outcome 2: Interpret, plan, produce and apply descriptive statistics.

- Assessment Plan

  o Assessment Tool: Common final exam questions

  o Assessment Date: Winter 2021

  o Course section(s)/other population: All

  o Number students to be assessed: 20% representative random sample of students completing the assessment instrument in each course section

  o How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

  o Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

  o Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2019	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed

678	120

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

> Of the 678 students enrolled in the course, 562 completed the required department-generated, cumulative final exam which includes the embedded course assessment questions.
>
> The course assessment plan requires that a representative random sample of 20% of the students (rounding the figure up to a whole number) completing the final exam from each section be selected for assessment. This was done and generated a total sample of 120 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

> There were 26 sections of the course offered in three different modalities (face-to-face, online, blended), four different parts of term, and with face-to-face meeting times during days and evenings, including an extension site class.
>
> The completed final exams from all 26 sections were received and included in this assessment.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

> (see additional narrative with Outcome 1)
>
> The assessment tool for this and the other outcomes is questions embedded within the required department-generated cumulative final exam.
>
> Summary of the process: Five Outcome 2 related questions from the required cumulative final exam were selected. Two instructors shared scoring responsibilities and graded each answer on a 1/0.5/0 scale. So, each student earned an Outcome 2 score between 0 and 5. Finally, the number of students out of 120 who scored at least 3.5 (70%) out of 5 was determined and converted to a percentage.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: <u>Yes</u>
106 out of 120 students scored 3.5 or better out of 5.

Restated: 88% of students scored 70% or better on Outcome 2.

The following table shows percentages of students scoring at least 70%, 80% and 90%, respectively.

Outcome 2 Score	Percentage of Students
≥ 70%	88%
≥ 80%	84%
≥ 90%	73%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

> Students showed strong results for this outcome, exceeding the success criterion for each question. They were particularly good at numerical measures of central tendency, determining boundaries for outliers, and interpreting the relationship of two variables.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

> Students succeeded but were less strong in computing variance and the least squares regression line. This is the pattern we always see. Instructors will need to continue to discuss and demonstrate examples of these topics.

Outcome 3: Interpret and apply probability, discrete probability distributions and common continuous probability distributions.

- Assessment Plan

  o Assessment Tool: Common final exam questions

  o Assessment Date: Winter 2021

  o Course section(s)/other population: All

  o Number students to be assessed: 20% representative random sample of students completing the assessment instrument in each course section

- How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

- Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

- Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2019	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
678	120

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Of the 678 students enrolled in the course, 562 completed the required department-generated, cumulative final exam which includes the embedded course assessment questions.

The course assessment plan requires that a representative random sample of 20% of the students (rounding the figure up to a whole number) completing the final exam from each section be selected for assessment. This was done and generated a total sample of 120 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

There were 26 sections of the course offered in three different modalities (face-to-face, online, blended), four different parts of term, and with face-to-face meeting times during days and evenings, including an extension site class.

The completed final exams from all 26 sections were received and included in this assessment.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

(see additional narrative with Outcome 1)

The assessment tool for this and the other outcomes is questions embedded within the required department-generated cumulative final exam.

Summary of the process: Five Outcome 3 related questions from the required cumulative final exam were selected. Two instructors shared scoring responsibilities and graded each answer on a 1/0.5/0 scale. So, each student earned an Outcome 3 score between 0 and 5. Finally, the number of students out of 120 who scored at least 3.5 (70%) out of 5 was determined and converted to a percentage.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

93 out of 120 students scored 3.5 or better out of 5.

Restated: 78% of students scored 70% or better on Outcome 3.

The following table shows percentages of students scoring at least 70%, 80% and 90%, respectively.

Outcome 3 Score	Percentage of Students
≥ 70%	78%
≥ 80%	63%
≥ 90%	43%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students were very strong at basic probability and discrete probability distribution work. They were also strong at calculations of probability using the normal distribution.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

An item analysis revealed that students struggled in dealing with sampling and inverse normal calculations. These are two challenging topics that typically produce weaker results, and they were both part of one question because of limitations on questions available within the online testing system. The topics will

continue to be emphasized. We will look to see if the availability of questions that separate these topics is expanded within the online testing system.

Students also had difficulty answering a question about whether a particular probability is unusual. The question required them to make a calculation as well as to classify the result. It may be that they did not all understand that a calculation was required. Or, it may be that not all remembered the typical standard for an unusual probability. Instructors will be asked to emphasize that standard as well as how to recognize when it and how it applies.

Outcome 4: Interpret, plan, produce and apply inferential statistics.

- Assessment Plan

  - Assessment Tool: Common final exam questions

  - Assessment Date: Winter 2021

  - Course section(s)/other population: All

  - Number students to be assessed: 20% representative random sample of students completing the assessment instrument in each course section

  - How the assessment will be scored: The selected set of common questions for this outcome from the paper and online versions of the approved department final exam will be matched and scored with a rubric

  - Standard of success to be used for this assessment: 70% of students will score at least 70% on the selected set of questions assessed for this outcome

  - Who will score and analyze the data: Course mentor (coordinator)/department faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2019	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
678	120

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

Of the 678 students enrolled in the course, 562 completed the required department-generated, cumulative final exam which includes the embedded course assessment questions.

The course assessment plan requires that a representative random sample of 20% of the students (rounding the figure up to a whole number) completing the final exam from each section be selected for assessment. This was done and generated a total sample of 120 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

There were 26 sections of the course offered in three different modalities (face-to-face, online, blended), four different parts of term, and with face-to-face meeting times during days and evenings, including an extension site class.

The completed final exams from all 26 sections were received and included in this assessment.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The assessment tool for this and the other outcomes is questions embedded within the required department-generated cumulative final exam.

Summary of the process: Five Outcome 4 related questions from the required cumulative final exam were selected. Two instructors shared scoring responsibilities and graded each answer on a 1/0.5/0 scale. So, each student earned an Outcome 4 score between 0 and 5. Finally, the number of students out of 120 who scored at least 3.5 (70%) out of 5 was determined and converted to a percentage.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

101 out of 120 students scored 3.5 or better out of 5.

Restated: 84% of students scored 70% or better on Outcome 4.

The following table shows percentages of students scoring at least 70%, 80% and 90%, respectively.

Outcome 4 Score	Percentage of Students
≥ 70%	84%
≥ 80%	78%
≥ 90%	68%

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students did well on all questions for this outcome. They were particularly good at correctly stating null and alternative hypotheses.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

While an item analysis showed that students met the success criterion for each question, they were weaker at reasoning based upon a confidence interval they had produced. It was pretty evident that many misunderstood what the question asked of them. This was related to the phrasing of the question in the online version (and therefore matched in the paper version). Instructors will be asked to help students recognize this question and what it intends.

III. Course Summary and Intended Changes Based on Assessment Results

1. Based on the previous report's Intended Change(s) identified in Section I above, please discuss how effective the changes were in improving student learning.

The changes to the course made based upon the previous assessment's recommendations were effective. In particular, the student performance on Outcome 3 was much improved. The change in the outcome language, combined with modification of the assessment instrument, together helped demonstrate that students succeeded in work on probability and discrete probability distributions, as well as on continuous probability distributions. This result is consistent with the 2006 assessment, which had Outcome 3 language much more like what was introduced after the 2017 assessment.

2. Describe your overall impression of how this course is meeting the needs of students. Did the assessment process bring to light anything about student achievement of learning outcomes that surprised you?

Our overall impression is that this course is well meeting the needs of students. There were not any new surprises based on the assessment questions used here, though it is clear that we need to continue to emphasize statistics vocabulary as

well as how to recognize what is being asked in reasoning about unusual probabilities or about confidence intervals.

One thing that was somewhat of a surprise was revealed in scoring hypothesis test questions. There was a higher rate of inconsistency shown than expected in answering in successive questions whether the null hypothesis is rejected or not and then what this means when restated in everyday language. This is a critical finding, and instructors will be asked to be sure to emphasize the connection.

3. Describe when and how this information, including the action plan, was or will be shared with Departmental Faculty.

Results will be shared with the department at a regular department meeting.

The course coordinator will share results with new and continuing part-time faculty.

4.

Intended Change(s)

Intended Change	Description of the change	Rationale	Implementation Date
Outcome Language	Rewrite Outcome 1.	As stated now it is all-encompassing and therefore overlaps with the other outcomes. This outcome should emphasize statistical terminology and representation of qualitative and quantitative information in tables and graphs. This report focused on those things in the assessment of Outcome 1.	2020
Outcome Language	Revise Outcome 2.	The current statement could be clearer in indicating what descriptive statistics are intended and to	2020

		emphasize that linear regression is included at the course outcome level.	
Other: Assessment sample size	Reexamine the number of students to be assessed.	This course has very high enrollment. The 20% sample size should be reduced to make the assessment manageable for one instructor (10% or the equivalent of 2 full sections would do). *or* The course assessment and syllabus together should be approved as a two instructor project meeting the contractual obligations for a course assessment and a syllabus revision for both instructors.	2020

5. Is there anything that you would like to mention that was not already captured?

Everything has been captured here or in the attachments.

III. Attached Files

MTH 160 Assessment Summary
MTH 160 Student Scores per Outcome
MTH 160 Scoresheet for Paper Final
MTH 160 Scoresheet for Online Final

Faculty/Preparer: James Egan **Date:** 07/15/2019
Department Chair: Lisa Manoukian **Date:** 07/22/2019

Dean: Kimberly Jones **Date:** 08/12/2019
Assessment Committee Chair: Shawn Deron **Date:** 10/10/2019

Discipline	Course Number	Title
Mathematics	160	MTH 160 06/06/2017- Basic Statistics
Division	Department	Faculty Preparer
Math, Science and Engineering Tech	Mathematics	James Egan
Date of Last Filed Assessment Report		

I. Assessment Results per Student Learning Outcome

Outcome 1: Interpret common statistical concepts and demonstrate critical consumption of statistical information.

- Assessment Plan

    o Assessment Tool: Common final exam questions.

    o Assessment Date: Spring/Summer 2018

    o Course section(s)/other population: Representative random sample (of size 35) from all students (F2F, DL, and MM) who take the final exam, including students who take the paper final as well as those who take the online final. Data on the entire population of students who take the online final exam will also be reviewed. The proportion of "successful" students will be estimated from the representative random sample that includes F2F, DL, and MM students; the proportion of successful online-final students will also be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

    o Number students to be assessed: 35 who take either version of the final, plus all who take the online final

    o How the assessment will be scored: The finals comprising the random sample (a combination of online and paper finals) will be scored according to a departmentally- developed rubric. While slight variations may exist with the online finals, those that are part of the sample will be examined and assessed using partial credit as closely as possible to the same methods for assessment for the paper finals. The group of all online finals taken will also be scored by computer using an answer key.

- o Standard of success to be used for this assessment: 70% of students participating score at least 75% on each common question.

- o Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2017	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
636	104

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

The assessment instrument is the department-generated common final exam, which has both paper and online versions. All 23 course sections administered the instrument and submitted the exams for this assessment. A total of 516 exams were submitted, but two sections were found to have used a shortened instrument and the 41 exams from those two sections could not be included in the analysis. This left 475 exams from 21 sections. Of these, a representative random sample of 20% (rounded up to a whole number) from each section was selected. Together these totaled 104 exams to be pooled and hand-scored.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

After excluding the two sections that used a shortened instrument, 20% of all students from all populations were included in the section-by-section random sampling. Therefore, all delivery modalities, day and evening classes, sites, parts of term, etc. were included.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The assessment instrument is the department-generated cumulative, common final exam, which has both paper and online versions. The questions on the online exam were matched part-by-part to the paper exams.

The paper version of the cumulative final consists of 46 questions. Of these 33 were noted as representative of the first outcome, a fairly general one reflecting

basics of descriptive statistics. Scoresheets were then set up to match these questions with the online versions and then all sampled finals were hand-scored with partial credit in a comparable manner.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

The prior assessment cycles used different criteria: 70% of students scoring 70% or better versus 70% of students scoring 75% or better on each question. Both standards are reported here, but as pooled results from the corresponding *block* of questions. Partial credit was not sensitive enough on many individual questions to support scoring to a 70% or 75% standard.

Success Standard	Percentage of Students Meeting or Exceeding Standard
70%	87%*
75%	82%*

*Interpolated

Students in all delivery modalities met the success standard, though those in traditional sections did particularly well.

A small examination of the exams from the two sections that used a shortened instrument showed them generally to have results comparable to those reported here.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

The assessment of the first outcome went deeper than the literal meaning of the outcome because interpretation of concepts and demonstration of critical consumption are most often embedded within problems also requiring sophisticated summarizations and calculations. Student performance more than met desired levels, and we are very satisfied with this result as a broad indicator of course success.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

The current course design and coverage already result in student achievement exceeding expectations. Some additonal focus on probability topics may be of benefit, though this is addressed in the discussion about outcome 3.

Outcome 2: Interpret, plan, produce and apply descriptive statistics.

- Assessment Plan

    o Assessment Tool: Common final exam questions.

    o Assessment Date: Spring/Summer 2018

    o Course section(s)/other population: Representative random sample (of size 35) from all students (F2F, DL, and MM) who take the final exam, including students who take the paper final as well as those who take the online final. Data on the entire population of students who take the online final exam will also be reviewed. The proportion of "successful" students will be estimated from the representative random sample that includes F2F, DL, and MM students; the proportion of successful online-final students will also be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

    o Number students to be assessed: 35 who take either version of the final, plus all who take the online final

    o How the assessment will be scored: The finals comprising the random sample (a combination of online and paper finals) will be scored according to a departmentally- developed rubric. While slight variations may exist with the online finals, those that are part of the sample will be examined and assessed using partial credit as closely as possible to the same methods for assessment for the paper finals. The group of all online finals taken will also be scored by computer using an answer key.

    o Standard of success to be used for this assessment: 70% of students participating score at least 75% on each common question.

    o Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2017	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
636	104

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

> (see details with outcome 1)
>
> Out of the 475 exams from 21 sections that used the full instrument, a representative random sample of 20% (rounded up to a whole number) of exams from each section was selected, for a total of 104 exams.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

> After excluding the two sections that used a shortened instrument, 20% of all students from all populations were included in the section-by-section random sampling. Therefore, all delivery modalities, day and evening classes, sites, parts of term, etc. were included.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

> The assessment instrument is the department-generated cumulative, common final exam, which has both paper and online versions. Eighteen questions from the paper version were noted as representative of the second outcome, which still reflects descriptive statistics but focuses more on graphical and numerical summarization of data sets. Scoresheets were then set up to match these questions with the online versions and all sampled finals were scored with partial credit in a comparable manner.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

> Met Standard of Success: Yes
>
> The prior assessment cycles used different criteria: 70% of students scoring 70% or better versus 70% of students scoring 75% or better on each question. Both standards are reported here, but as pooled results from the corresponding *block* of questions. Partial credit was not sensitive enough on many individual questions to support scoring to a 70% or 75% standard.

Success Standard	Percentage of Students Meeting or Exceeding Standard
70%	87%*
75%	78%

*Interpolated

Students in all delivery modalities met the success standard, with nearly identical rates at the 70% standard.

A small examination of the exams from the two sections that used a shortened instrument showed them generally to have results comparable to those reported here.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students demonstrated the ability to work with data sets and the graphical and numerical summarization of data using technology.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

The course requires the use of the TI-84 graphing calculator as a simple-to-use instrument for statistical procedures reflecting the modern approach to statistics and which will translate to other statistical platforms in science, health, business and other disciplines. However, it was clear that some students did not use the statistical functions of the calculator, and their results were poorer. The department will continue to emphasize the importance of technology as the only practical and scalable approach to statistics and that its use improves both performance and understanding.

Outcome 3: Interpret and apply common probability distributions.

- Assessment Plan

    o Assessment Tool: Common final exam questions

    o Assessment Date: Spring/Summer 2018

    o Course section(s)/other population: Representative random sample (of size 35) from all students (F2F, DL, and MM) who take the final exam, including students who take the paper final as well as those who take the online final. Data on the entire population of students who take the online final exam will also be reviewed. The proportion of "successful" students will be estimated

from the representative random sample that includes F2F, DL, and MM students; the proportion of successful online-final students will also be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

- o Number students to be assessed: 35 who take either version of the final, plus all who take the online final

- o How the assessment will be scored: The finals comprising the random sample (a combination of online and paper finals) will be scored according to a departmentally- developed rubric. While slight variations may exist with the online finals, those that are part of the sample will be examined and assessed using partial credit as closely as possible to the same methods for assessment for the paper finals. The group of all online finals taken will also be scored by computer using an answer key.

- o Standard of success to be used for this assessment: 70% of students participating score at least 75% on each common question.

- o Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2017	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
636	104

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

(see details with outcome 1)

Out of the 475 exams from 21 sections that used the full instrument, a representative random sample of 20% (rounded up to a whole number) of exams from each section was selected, for a total of 104 exams.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

After excluding the two sections that used a shortened instrument, 20% of all students from all populations were included in the section-by-section random sampling. Therefore, all delivery modalities, day and evening classes, sites, parts of term, etc. were included.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The assessment instrument is the department-generated cumulative, common final exam, which has both paper and online versions. Ten questions from the paper version were noted as representative of the third outcome, which corresponds to probability, discrete and continuous probability distributions and the basics of sampling theory. Scoresheets were then set up to match these questions with the online versions and all sampled finals were scored with partial credit in a comparable manner.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: No

The prior assessment cycles used different criteria: 70% of students scoring 70% or better versus 70% of students scoring 75% or better on each question.   Both standards are reported here, but as pooled results from the corresponding *block* of questions. Partial credit was not sensitive enough on many individual questions to support scoring to a 70% or 75% standard.

Success Standard	Percentage of Students Meeting or Exceeding Standard
70%	62%
75%	56%

Students in all delivery modalities fell short of the success standard, particularly those in online sections.

A small examination of the exams from the two sections that used a shortened instrument showed them generally to have results comparable to those reported here.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

This outcome has historically seen the weakest results, and in this assessment student achievement again did not reach the targeted level. However, other

student work does seem to indicate reasonable appreciation of related topics. Some possibilities for not achieving desired performance levels and thoughts about these:

- o Probability is a new and challenging topic for most students. The current results are not surprising or discouraging, though we hope to improve them in the future.

- o The assessment questions for this outcome tend to reflect the most challenging topics in the related material. In the prior assessment, this was even more the case. The set of questions was expanded for the current assessment, though they still reflected mostly a single topic and results did not change. The set of questions needs to reflect more in the way of very basic probability and discrete probability distributions.

- o The questions all still required proper use of the calculator, and where students did not use it correctly, poor results may have reflected that rather than a lack of understanding.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

This is an area in which both the *assessment* of student work as well as the work itself could improve. Toward that end:

1. The outcome language needs to be rewritten to reflect the inclusion of basic probability and discrete probability distributions and that these topics will be assessed. This is not a course change, but rather a clarification, as these topics have always been intended as part of this course outcome.

2. The assessment instrument needs to be modified to better reflect the entire outcome.

3. More emphasis needs to be given on the recognition of sampling situations.

4. More emphasis needs to be given to make sure students know the correct computational procedures on the TI-84 calculator for both discrete and normal distributions, including sampling distributions with quantitative and proportions data.

5. Online students did notably worse on outcome 3 than those in traditional or blended sections. Online instructors will be reminded to provide or encourage additional review and practice on probability-related topics.

Outcome 4: Interpret, plan, produce and apply inferential statistics.

- Assessment Plan

  - Assessment Tool: Common final exam questions

  - Assessment Date: Spring/Summer 2018

  - Course section(s)/other population: Representative random sample (of size 35) from all students (F2F, DL, and MM) who take the final exam, including students who take the paper final as well as those who take the online final. Data on the entire population of students who take the online final exam will also be reviewed. The proportion of "successful" students will be estimated from the representative random sample that includes F2F, DL, and MM students; the proportion of successful online-final students will also be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

  - Number students to be assessed: 35 who take either version of the final, plus all who take the online final

  - How the assessment will be scored: The finals comprising the random sample (a combination of online and paper finals) will be scored according to a departmentally- developed rubric. While slight variations may exist with the online finals, those that are part of the sample will be examined and assessed using partial credit as closely as possible to the same methods for assessment for the paper finals. The group of all online finals taken will also be scored by computer using an answer key.

  - Standard of success to be used for this assessment: 70% of students participating score at least 75% on each common question.

  - Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2017	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
636	104

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

(see details with outcome 1)

Out of the 475 exams from 21 sections that used the full instrument, a representative random sample of 20% (rounded up to a whole number) of exams from each section was selected, for a total of 104 exams.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

After excluding the two sections that used a shortened instrument, 20% of all students from all populations were included in the section-by-section random sampling. Therefore, all delivery modalities, day and evening classes, sites, parts of term, etc. were included.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

The assessment instrument is the department-generated cumulative, common final exam, which has both paper and online versions. Thirteen questions from the paper version were noted as representative of the fourth outcome, which corresponds to inferential statistics. Scoresheets were then set up to match these questions with the online versions and all sampled finals were scored with partial credit in a comparable manner.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

The prior assessment cycles used different criteria: 70% of students scoring 70% or better versus 70% of students scoring 75% or better on each question. Both standards are reported here, but as pooled results from the corresponding *block* of questions. Partial credit was not sensitive enough on many individual questions to support scoring to a 70% or 75% standard.

Success Standard	Percentage of Students Meeting or Exceeding Standard
70%	86%*
75%	85%*

*Interpolated

Students in all delivery modalities exceeded the success standard.

A small examination of the exams from the two sections that used a shortened instrument showed them generally to have results comparable to those reported here.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students did very well in the area of inferential statistics. In fact, about 60% of students reached a level of 90% success on the block of questions used to assess this outcome. In particular, almost all students correctly selected the appropriate statistical procedures for the various inferential statistics scenarios.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Students do not do as well at translating the results of statistical analyses into common language, so this needs additional reinforcement. In addition, small numbers of students consistently reverse the conclusion of a test of hypotheses, a very serious error. Instructors need to watch for this and give some individualized attention to those students.

II. Course Summary and Action Plans Based on Assessment Results

1. Describe your overall impression of how this course is meeting the needs of students. Did the assessment process bring to light anything about student achievement of learning outcomes that surprised you?

My overall impression is that this course is well meeting the needs of students. However, it was notable that not all students in some sections were using the required TI-84 calculator's statistical functions as intended in requiring that calculator for the course. Because most students in those sections did use the statistical functions, it is evident that the instructors are communicating the appropriate calculator instructions. It may be necessary to have students separately demonstrate use of the statistical functions before proceeding to exams.

2. Describe when and how this information, including the action plan, was or will be shared with Departmental Faculty.

Details will be shared at course coordinator meetings with the instructors teaching the course. A general summary will also be provided at a department meeting.

3.
Intended Change(s)

Intended Change	Description of the change	Rationale	Implementation Date
Outcome Language	Modify the phrasing of outcome 3 to better reflect the intended inclusion of basic probability and discrete probability distributions.	This will better focus instruction of these topics and support modifying the assessment instrument to include them.	2018
Assessment Tool	o Modify the instrument to better assess outcome 3 in the areas of basic probability and discrete distributions. o Shorten the paper version of the final exam and match the online version to that. Note: Such modifications remain subject to the limits of the available pool of questions included with Connectmath.	o This will then align with the intended change to the language of outcome 3. o Instructors using the paper final exam report it is too long for some students to complete in a standard class session. It can be shortened and still measure all course outcomes appropriately.	2018
Other: Assessment Sampling & Success Criterion	o Modify the course assessment to use representative random samples of 20% of students (rounded up to a whole number) from all sections. o Modify the criterion for	o Cross-matching paper and online versions of the department-approved final exam and then hand scoring them necessitates using sampling. The 20% sampling standard is suitable for a course with very large enrollments such as this one. o This criterion works well and is commonly	2018

	each outcome to be that 70% of students will score 70% or better on the corresponding assessment instrument/block of questions.	used for WCC assessments. Students scoring at least 70% on a cumulative final exam typically earn overall grades that are transferable to other institutions.	

4. Is there anything that you would like to mention that was not already captured?

(NA)

III. Attached Files

Assessment Report Summary
Paper Exam Scoresheet
Online Exam Scoresheet
(do not share) W17 Paper Final
(do not share) answers to W17 Paper Final
(do not share) W17 Online Final
Assessment Raw Scores and Analysis
Assessment Tabulations

Faculty/Preparer: James Egan **Date:** 06/26/2017
Department Chair: Lisa Rombes **Date:** 06/29/2017
Dean: Kristin Good **Date:** 07/05/2017
Assessment Committee Chair: Michelle Garey **Date:** 10/18/2017

Discipline	Course Number	Title
Mathematics	160	MTH 160 07/16/2015-Basic Statistics
Division	Department	Faculty Preparer
Math, Science and Engineering Tech	Mathematics	Robert Klemmer
Date of Last Filed Assessment Report		

I. Assessment Results per Student Learning Outcome

Outcome 1: Interpret common statistical concepts and demonstrate critical consumption of statistical information.

- Assessment Plan

    o Assessment Tool: Common final exam questions.

    o Assessment Date: Winter 2014

    o Course section(s)/other population: Representative random sample of students who take the paper final exam, and all students who take an online final exam. All DL students take the online final. MM students may take either final and will be represented in both groups accordingly. The proportion of "successful" paper-final students will be estimated; the proportion of successful online-final students will be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

    o Number students to be assessed: 35 who take the paper final, plus all who take the online final

    o How the assessment will be scored: The paper final will be scored according to a departmentally- developed rubric. The online final will be scored by computer using an answer key.

    o Standard of success to be used for this assessment: 70% of students participating score at least 70% on each common question.

    o Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2015	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
423	35

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of the statistical assumptions. Using statistics from our sample, we are able to draw a very reasonable conclusion about the entire population of 160 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

All final exams were collected from Winter 2015 Math 160 instructors. I used a random number generator in my calculator to randomly select paper finals of students who took 160 in a face-to-face or MM format. I also tabulated the scores of all students who took an online final (all DL and some MM students).

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

This first outcome is a relatively general one and is involved in all aspects of the course. For this reason, I graded all 28 questions from the 35 final exams using an answer key (with a rubric for assigning partial credit). Then, I determined the number of students who achieved at least a 70% average on the entire exam.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes

86% of students from the sample earned at least a 70% on the 28 questions from the final exam. Using hypothesis testing, it is more than reasonable to conclude that more than 75% of ALL students taking the paper final scored above 70%. In addition, 90% of those taking the online final earned a minimum of 70%. Overall, we are very satisfied with these results.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

> The first learning outcome covers the entire course, and the clear areas of strength are the first (descriptive stats) and last units (inferential stats). Students certainly demonstrate an understanding of common statistics vocabulary and notation, and they also have the ability to draw sound inferences based upon results provided by the graphing calculator.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

> Students exceeded expectations on much of the final exam, but did not demonstrate the ability to critically understand the various types of normal distributions (mainly, the distribution of sample means). The second major unit of the course, Probability, needs to be reviewed by faculty so that we can find ways to effectively teach this challenging unit to our students.

Outcome 2: Interpret, plan, produce and apply descriptive statistics.

- Assessment Plan
    - o Assessment Tool: Common final exam questions.
    - o Assessment Date: Winter 2014
    - o Course section(s)/other population: Representative random sample of students who take the paper final exam, and all students who take an online final exam. All DL students take the online final. MM students may take either final and will be represented in both groups accordingly. The proportion of "successful" paper-final students will be estimated; the proportion of successful online-final students will be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).
    - o Number students to be assessed: 35 who take the paper final, plus all who take the online final
    - o How the assessment will be scored: The paper final will be scored according to a departmentally- developed rubric. The online final will be scored by computer using an answer key.

- o   Standard of success to be used for this assessment: 70% of students participating score at least 70% on each common question.
- o   Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2015	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
423	35

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of the statistical assumptions. Using statistics from our sample, we are able to draw a very reasonable conclusion about the entire population of 160 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

All final exams were collected from Winter 2015 Math 160 instructors. I used a random number generator in my calculator to randomly select paper finals of students who took 160 in a face-to-face or MM format.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

This second outcome covers material from both the first third of the course and approximately the first third of the final. For this reason, I graded questions 1-16 from the 35 final exams using an answer key (with a rubric for assigning partial credit). Then, I determined the number of students who achieved at least a 70% average on these 16 questions.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

91% of students from the sample earned at least a 70% on questions 1-16 from the final exam. Using hypothesis testing, it is more than reasonable to conclude that more than 80% of ALL students taking the paper final scored above 70%. Students performed the best on this particular learning outcome. Overall, we are very satisfied with these results.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students learn to use the calculator a lot in this course, as intended. They clearly have demonstrated the abiity to produce and interpret many common statistics with the aid of technology.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

While we focus on the use of the calculator in this course, we will continue to work on improving student conceptual understanding of the major statistics in the course. At the same time, we are also considering the integration of alternative forms of technology, such as computer software that is utilized by statisticians in the business world.

Outcome 3: Interpret and apply common probability distributions.

- Assessment Plan

    o Assessment Tool: Common final exam questions

    o Assessment Date: Winter 2014

    o Course section(s)/other population: Representative random sample of students who take the paper final exam, and all students who take an online final exam. All DL students take the online final. MM students may take either final and will be represented in both groups accordingly. The proportion of "successful" paper-final students will be estimated; the proportion of successful online-final students will be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

    o Number students to be assessed: 35 who take the paper final, plus all who take the online final

- How the assessment will be scored: The paper final will be scored according to a departmentally- developed rubric. The online final will be scored by computer using an answer key.

- Standard of success to be used for this assessment: 70% of students participating score at least 70% on each common question.

- Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2015	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
423	35

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of the statistical assumptions. Using statistics from our sample, we are able to draw a very reasonable conclusion about the entire population of 160 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

All final exams were collected from Winter 2015 Math 160 instructors. I used a random number generator in my calculator to randomly select paper finals of students who took 160 in a face-to-face or MM format.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

This third outcome covers those questions that deal specifically with the normal probability distribution used for normal populations and sample means. For this reason, I graded questions 17-21 from the 35 final exams using an answer key (with a rubric for assigning partial credit). Then, I determined the number of students who achieved at least a 70% average on these 5 questions.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: <u>No</u>
60% of students from the sample earned at least a 70% on questions 17-21 from the final exam. Using hypothesis testing, it is more than reasonable to conclude that LESS THAN 75% of ALL students taking the paper final scored above 70% on these questions. It is also *fairly* reasonable to conclude that less than 70% of ALL students taking the paper final scored above 70% on these questions. Students performed the worst on this particular learning outcome. Overall, we are NOT satisfied with these results.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Based upon the 35 paper final exams, students demonstrated the ability to recognize when to utilize technology for finding probabilities associated with normal distributions, and many students also showed an understanding of the proper technological tools to use when finding probabilities and percentiles.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Students main struggle with this outcome involved choosing the appropriate probability distribution: normal population, distribution of sample means, or distribution of sample proportions. If we can help students discover the appropriate distribution and teach them how to use certain formulas (e.g., standard deviation) associated with the specific distributions, then we can dramatically improve the results of this outcome.

Outcome 4: Interpret, plan, produce and apply inferential statistics.

- Assessment Plan

    o Assessment Tool: Common final exam questions

    o Assessment Date: Winter 2014

    o Course section(s)/other population: Representative random sample of students who take the paper final exam, and all students who take an online final exam. All DL students take the online final. MM students may take either final and will be represented in both groups accordingly. The proportion of "successful" paper-final students will be estimated; the

proportion of successful online-final students will be calculated directly. The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of conditions (population size at least 20 times greater than the sample size).

- o Number students to be assessed: 35 who take the paper final, plus all who take the online final

- o How the assessment will be scored: The paper final will be scored according to a departmentally- developed rubric. The online final will be scored by computer using an answer key.

- o Standard of success to be used for this assessment: 70% of students participating score at least 70% on each common question.

- o Who will score and analyze the data: Departmental faculty

1. Indicate the Semester(s) and year(s) assessment data were collected for this report.

Fall (indicate years below)	Winter (indicate years below)	SP/SU (indicate years below)
	2015	

2. Provide assessment sample size data in the table below.

# of students enrolled	# of students assessed
423	35

3. If the number of students assessed differs from the number of students enrolled, please explain why all enrolled students were not assessed, e.g. absence, withdrawal, or did not complete activity.

The sample size of 35 is chosen specifically to satisfy the conditions for valid inference in this setting. It is large enough; a larger sample would actually break one of the statistical assumptions. Using statistics from our sample, we are able to draw a very reasonable conclusion about the entire population of 160 students.

4. Describe how students from all populations (day students on campus, DL, MM, evening, extension center sites, etc.) were included in the assessment based on your selection criteria.

All final exams were collected from Winter 2015 Math 160 instructors. I used a random number generator in my calculator to randomly select paper finals of students who took 160 in a face-to-face or MM format.

5. Describe the process used to assess this outcome. Include a brief description of this tool and how it was scored.

This fourth outcome covers those questions that deal specifically with the inferential statistics of confidence intervals and hypothesis testing (the same things that I am using to assess the course :)). For this reason, I graded questions 22-28 from the 35 final exams using an answer key (with a rubric for assigning partial credit). Then, I determined the number of students who achieved at least a 70% average on these 7 questions.

6. Briefly describe assessment results based on data collected for this outcome and tool during the course assessment. Discuss the extent to which students achieved this learning outcome and indicate whether the standard of success was met for this outcome and tool.

Met Standard of Success: Yes
89% of students from the sample earned at least a 70% on questions 22-28 from the final exam. Using hypothesis testing, it is more than reasonable to conclude that more than 75% of ALL students taking the paper final scored above 70% on these questions. Students performed very well on this particular learning outcome, exceeding expectations. Overall, we are very satisfied with these results.

7. Based on your interpretation of the assessment results, describe the areas of strength in student achievement of this learning outcome.

Students are quite comfortable recognizing the differences between a confidence interval and hypothesis test, the differences between a problem that involves means or proportions, the differences between 1-sample and 2-sample problems, and the differences between questions that provide population standard deviation or not. They are also quite comfortable using the calculator to find confidence intervals and p-values, and they interpret these findings from the calculator rather well, too.

8. Based on your analysis of student performance, discuss the areas in which student achievement of this learning outcome could be improved. If student met standard of success, you may wish to identify your plans for continuous improvement.

Much current research uses the inferential statistics methods taught in this learning outcome from our course. If we can continue to connect the classroom with the outside world (and we have a perfect opportunity to do so with this material in this class), then students will build upon their already-impressive critical consumption of inferential statistics.

II. Course Summary and Action Plans Based on Assessment Results

1. Describe your overall impression of how this course is meeting the needs of students. Did the assessment process bring to light anything about student achievement of learning outcomes that surprised you?

After completing the assessment and reflecting on my own personal teaching experiences, I feel that Math 160 at WCC is doing a great job meeting the needs of the vast majority of our students. In addition to the fact that more than 86% of students in both the sample and those who took the final online scored above 70%, the average final exam grade for the sample was over 83% and the average of all online finals was over 86%!

While teaching methods of instructors vary, most are teaching this course using a calculator-based approach that appears to be providing students with many opportunities to produce and apply basic statistical information. The course can be taught with much more of an algebraic emphasis, but our focus seems most appropriate for the groups of students with whom we are working.

Truthfully, I was not surprised at many of these results when doing the assessment. Probability (outcome 2) is a challenging unit for students in many math classes, and it seems particularly challenging for our 160 students due to the inherent conceptual challenges of understanding various probability distributions and the incorporation of some algebra into these sections.

2. Describe when and how this information, including the action plan, was or will be shared with Departmental Faculty.

As the course mentor for Math 160, I intend to present my findings to all instructors when we meet during breakout sessions at our department meeting to begin the year. Also, as new instructors begin teaching at WCC, I will share these assessment results with them as well.

3.

Intended Change(s)

Intended Change	Description of the change	Rationale	Implementation Date
Outcome Language	I would like to change the standard of success in the syllabus for all outcomes to be 75%.	The results from this assessment revealed that it was reasonable to conclude that more than 70% of ALL students taking the final scored above 75% on outcomes 1, 2, and 4. It is clear	2015

		that our students have raised the bar for us in this regard. At the same time, students who earn a 70% in our class do not earn a passing grade; so, it seems quite logical to me to raise the standard of success to a C level.	
Assessment Tool	I will be sure that all instructors giving the online final exam are giving the exact same final with the exact same policies. While doing this assessment, I noticed that instructors gave the same online finals, although the policies were all slightly different. For example, one instructor gave his students only one attempt at each question, many gave at most two attempts at each question, and one instructor actually gave unlimited attempts at each question. In addition, Connect Math, our web-based system for homework and	We need to maintain a high level of consistency for our 160 students who take the course online, so we should provide equitable opportunities for success on the final exam. At the same time, it becomes difficult to assess student understanding when they have many attempts at some of these online questions.	2015

	exams in the course, provides detailed item analyses for all assignments and exams, but the results are not particularly valid unless students only have exactly one attempt at each question. When meeting with 160 instructors to begin the year, we will agree on the policies for the online final.		
Course Materials (e.g. textbooks, handouts, on-line ancillaries)	We are in the process of incorporating a new technological tool into 160, beginning in Winter 2016. Learnsmart, as a supplement to Connect, will allow students the opportunity to do a "smart review" with major topics throughout the course.	Learnsmart is a soon-to-be added feature with Connect, and some faculty in the department have spoken highly of the possibilities after piloting the system. With our course, it can help students continue to work on their weaknesses, especially those within the probability unit, throughout the entire course.	2016

4. Is there anything that you would like to mention that was not already captured?

> 5.

III. Attached Files

Final Exam Key
160 Assessment Data

Faculty/Preparer: Robert Klemmer **Date:** 07/28/2015
Department Chair: Lisa Rombes **Date:** 07/29/2015
Dean: Kristin Good **Date:** 07/29/2015
Assessment Committee Chair: Michelle Garey **Date:** 09/21/2015

COURSE ASSESSMENT REPORT

Background Information
1. Course assessed:
    Course Discipline Code and Number: MTH 160
    Course Title: Basic Statistics
    Division/Department Codes: MNBS/MTH

2. Semester assessment was conducted (check one):
    ☐ Fall 20__
    ☒ Winter 20*CC*
    ☐ Spring/Summer 20__

3. Assessment tool(s) used: check all that apply.
    ☐ Portfolio
    ☒ Standardized test
    ☐ Other external certification/licensure exam (specify):
    ☐ Survey
    ☐ Prompt
    ☐ Departmental exam
    ☐ Capstone experience (specify):
    ☒ Other (specify): (A standardized list of questions was developed for use in all assessed sections.
Instructors of the sections gave these to the students.)

4. Have these tools been used before?
    ☐ Yes
    ☒ No

    If yes, have the tools been altered since its last administration? If so, briefly describe changes made.
    (NA)

5. Indicate the number of students assessed/total number of students enrolled in the course.
    Total original enrollments: 61 + 63 = 124. The group of 61 students (2 sections) received the questions as part of course testing. The group of 63 students (2 sections) received the questions as a supplement after completing midterms--the questions were not part of their exam grades. Instead, these students were encouraged to complete the questions. It was determined that this did not result in sufficiently serious participation on the assessment items. However, the performance of these students on comparable questions that were included for test evaluation indicated that their overall achievement was comparable to the other students for course assessment. Therefore, students included for primary analysis here were from the aforementioned group of 61 who were required to complete the assessment questions as part of course testing and who completed the course with a grade of C– or better. The specific number of participants varied for each assessement question, as the questions were given at different times with different students present.

6. Describe how students were selected for the assessment.
    All present were assessed in the primary sections (those requiring assessment as part of testing). Students in the other sections were encouraged to participate.

Results
1. Briefly describe the changes that were implemented in the course as a result of the previous assessment.
    Informal assessment by discussion of department faculty who teach this course is ongoing. Discussions have reviewed and updated the textbook selection and required the use of the TI-83+ (or TI-84+) graphing claculator. Several instructors have taken the role of preparing the course syllabus, each reviewing the syllabus outcomes and course coverage. There has been consistent agreement on these without need of change.

2. State each outcome from the master syllabus that was assessed.
   [Outcomes are listed, followed by objectives associated with those outcomes.]

   1. Interpret common statistical concepts and be critical consumers of statistical information.
      1-1 Use standard statistics terminology.
      1-2 Classify variables and types of data. [Note: All subsequent objectives also support Outcome #1]

   2. Interpret, plan, produce and apply descriptive statistics.
      2-1 Recognize and critique varied descriptive statistical summaries such as tables, graphs, and numerical measures.
      2-2 Tabulate data and prepare varied statistical summaries such as tables, graphs, and numerical measures.

   3. Interpret and apply common discrete and continuous distributions.
      3-1 Solve counting and probability exercises that underlie principles of probability distributions.
      3-2 Interpret, construct and apply discrete probability distributions including the binomial distribution.
      3-3 Interpret and apply normal probability distributions.
      3-4 Summarize attributes of sampling distributions and recognize their connection to the normal distribution.

   4. Interpret, plan, produce and apply inferential statistics.
      4-1 Interpret, construct and apply confidence intervals and calculate sample sizes.
      4-2 Interpret and develop statistical hypotheses for one and two populations.
      4-3 Make statistical tests of hypotheses about means and proportions for one and two populations using z and t distributions.
      4-4 Interpret and make inferences based upon hypothesis tests.

3. Briefly describe assessment results based on data collected during the course assessment, demonstrating the extent to which students are achieving each of the learning outcomes listed above. Please attach a summary of the data collected.
   All four course outcomes were assessed by administering to students questions designed to correspond to the specific syllabus objectives for those outcomes. Participating instructors selected the common set of questions (used for all students) from a larger set developed for this purpose. The general pattern strongly confirms that students are achieving the desired course outcomes. Participating instructors met to review and discuss all of the results. [See: data collection attachment for outcomes & objectives analysis. See also: discussion below]

4. For each outcome assessed, indicate the standard of success used, and the percentage of students who achieved that level of success.
   The nominal goal was that 70% of students who successfully pass the course with a grade of C– or better would be able to meet the scoring standard for success (also 70%) for each question. A brief summary: Combining objectives together for each outcome produced aggregate rates of 82% (1st objective), 94% (2nd objective), 90% (3rd objective), and 80% (4th objective). Regarding particular objectives, only two fell below the nominal standards. One (Item 3-2) dealt with the binomial distribution, and many who did not meet the standard made a calculation error that affected two of four items worth one point apiece. This single error automatically resulted in a score below criterion. It was observed that the test item differed somewhat from the organization used to study the binomial distribution in class. The item might not have been recognized because of this. The other (Item 4-2) dealt with distinguishing hypotheses based upon statements of equality and inequality. In fact, it was felt that some of the test items were enough different from the statements of hypotheses used in the course and common practice that they were more challenging than necessary for success. [See: data collection attachment for outcomes & objectives analysis. See also: discussion below]

COURSE ASSESSMENT REPORT

5. Describe the areas of strength and weakness in students' achievement of the learning outcomes shown in assessment results.

> Strengths: Students were strong in all areas, but particularly so on the 2nd and 3rd outcomes. These are areas in which students must create/interpret/apply descriptive statistics and work with discrete and continuous distributions. The 1st and 4th outcomes were also successfully met, though the results were not as strong as for the others. These outcomes focus on statistical terminology and inferential thinking. Regarding statistics terminology and data classification, the objectives were tested very early in the course. As noted in the master syllabus, these topics are actually included in all the other course outcomes and objectives. As such, it is felt that student outocmes were in fact much higher than the early indicators showed. Regarding inferential statistics, this topic is more challenging by nature in that it requires careful analysis of conditional cases and language that may inlude frequent use of inequalities and logical negatives and double negatives. Students with only an introductory algebra background typically have minimal preparation for this

> Weaknesses: Overall, it was not felt that there were weakness that require changes to the course. Nonetheless, overall results will be shared with the department so as to optimize instruction of the course.

Changes influenced by assessment results

1. If weaknesses were found (see above) or students did not meet expectations, describe the action that will be taken to address these weaknesses, along with a timeline for these actions.

> Recommendations to course instructors include: Emphasis on correct use of terms and symbols of statistics, including having students recognize/use terminology and symbols in their work as often as possible. Emphasis on stating/recognizing Null and Alternative Hypotheses. These recommendations will be made immediately with the submission of this report at a scheduled department meeting.

> For future assesements, it will be emphasized that the assessment items need to be included in the scoring of evaluated materials such as tests or quizzes (or, at the very least, not given as supplements following lengthy regular testing). This, too, will be recommended to the department for this course and others.

2. Identify any other intended changes that will be instituted based on results of this assessment activity (check all that apply). Please describe changes and give rationale for change.

☐ Master syllabus
Change/rationale:

☐ Curriculum
Change/rationale:

☐ Course syllabus
Change/rationale:

☐ Course assignments
Change/rationale:

☐ Course materials (check all that apply)
    ☐ Textbook
    ☐ Handouts
    ☐ Other:
Change/rationale:

☐ Instructional methods
Change/rationale:

☐ Other:
Change/rationale:

Please return completed form to the Office of Curriculum & Assessment, SC 247.

Future plans
1. Describe the extent to which the assessment tools used were effective in measuring student achievement of learning outcomes for this course.
    The assessment items worked well and will be retained for future use, with possible exceptions as noted below. The larger inventory will be available for assessment use.

2. If the assessment tools were not effective, describe the changes that will be made for future assessments.
    The assessment question used for Objective 3-2 may, at individual instructor's discretion, be split so that the parts of the questions are asked in a more recognizable context. The assessment question used for Objective 4-2 will be modified to use more typical statements of Null and Alternative Hypotheses.

Submitted by:

Name: _____   Date: _____

Department Chair: _____   Date: 6/26/06

Dean: _____   Date: 7/3/06